

field being applied by a second order power. Accordingly, the relationship between the mechanical change of shape and applied electric field is not a linear term. An electrorestrictive material thus has a greater response than merely ferroelectric or piezoelectric materials.

Nowhere does Butcher disclose the use of a piezoelectric material and a ferroelectric material, as recited in each of claims 1, 13 and 15. Butcher merely makes various references to piezoelectric materials whereby poling is not essential. See, for example, page 2, lines 17-21 and lines 30-34 as well as page 5, lines 17-18. The references made in Butcher clearly indicate that Butcher only discloses electrorestrictive materials. Since Butcher only discloses electrorestrictive materials, the relationship between the mechanical change of shape and the applied electric field is not linear.

Moreover, there is no phase dependency between the induced output signal and the direction of polarization. Butcher explicitly states that a device employing electrorestrictive materials does not maintain phase dependency. See, for example, page 2, lines 30-34 and the paragraph bridging pages 2-3.

Applicant therefore submits that Butcher is a completely different device than that of the present invention because Butcher merely discloses electrorestrictive materials, or in general terms, piezoelectric materials. Specifically, Butcher nowhere discloses use of a ferroelectric material, as recited in claims 1, 13 and 15. The basis for the fundamental nature of the present invention and why a ferroelectric material layer is essential was clearly set forth in detail in the Request for Reconsideration filed on November 1, 2002 as follows:

With a piezoelectric material, electrical polarization is always in the same polarity direction as an applied electric field, and when the electric field is removed, the electrical polarization is not retained in the material, i.e., there is no remnant polarization. Ferroelectric materials exhibit polarization hysteresis and electrical polarization that is not always in the same polarity direction as an applied electric field. For example, the application of a positive electrical field across a ferroelectric material layer can cause the material to change from

a remnant negative polarization state to a remnant positive polarization state, and vice versa.

This remnant polarization of ferroelectric materials would give rise to problems if used as the piezoelectric crystals because the polarization hysteresis, which gives rise to remnant polarization, is a variable property which would give rise to a variation in the resonant frequency exhibited by the material.

The present invention necessarily requires at least one of the clamped layers to be a ferroelectric material because the remnant polarization exhibited by the ferroelectric material is used to particular effect. When an electric field is applied in parallel or anti-parallel (i.e., in the same or opposite polarity direction) to the remnant polarization, the strains induced along the polarization axis of the material are either in-phase or out-of-phase to the applied external field. This phase relationship is dependent upon the polarization direction of the remnant polarization in the ferroelectric material. Thus, if an input signal is applied, for example, to a piezoelectric material which is clamped to a ferroelectric material, the piezoelectric material will expand and contract (deform) in phase with the phase of the input signal. This is because, as explained above, in a piezoelectric material the polarization, and hence strain, induced in the material always has the same polarity or sign as the applied electric field.

The strain induced in the piezoelectric material is then passed to the layer of ferroelectric material, which has remnant polarization. However, the strain, and thus electric polarization, induced in the ferroelectric layer may be either in-phase or out-of-phase with the remnant polarization of the ferroelectric layer. The output signal will therefore depend upon this in-phase or out-of-phase relationship. Thus, as disclosed in the present application, by selection of the properties and geometry of the materials of the layers, the clamped structure of the invention can be used to provide an amplifier, transformer, comparator or inverter.

See Pages 3 and 4 of the Request for Reconsideration filed on November 1, 2002.

Thus, it is not tenable to suggest that Butcher anticipates the present invention because there is no mention whatsoever of the presence of a ferroelectric material layer. In addition, Butcher makes no reference to providing a predetermined direction of polarization of the ferroelectric material nor that the induced output signal does not affect the polarization direction, and certainly not that the induced output signal has a phase which is determined by the polarization direction. Accordingly, in view of the fact that Butcher makes no reference whatsoever to these features of the present invention, the present invention is clearly novel over Butcher.

For the foregoing reasons, Applicant respectfully submits that Butcher fails to anticipate the subject matter of claims 1, 13 and 15 or any of depending claims 2 and 14. Reconsideration and withdrawal of this rejection are respectfully requested.

II. Claim Rejections under 35 U.S.C. §103(a)

Claims 6 and 7 were rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Butcher in view of U.S. Patent No. 4,868,447 (Lee)*. This rejection is respectfully traversed.

Claim 7 depends from claim 6, which in turn depends from claim 1.

Claim 6 recites the comparator having a device as claimed in claim 1, and further having a third layer of material clamped together with the other two layers, the third layer being a ferroelectric material.

Claim 7 recites the comparator of claim 6, wherein a first input electrode is provided on one of the layers, a second input electrode is provided on another of the layers, a common electrode is provided between the layers having the input electrodes, and an output electrode is provided on the third layer, the input electrodes being disposed on opposite sides of their respective layers compared with the common electrode.

Lee was cited as allegedly disclosing three layers of piezoelectric/ferroelectric layers wherein the electrodes are disposed on the top, bottom and sides of each laminate layer for the purpose of inducing bending and torsional movement.

However, Lee merely discloses a device comprising piezoelectric polymer laminates, which are used as sensors and actuators to sense and/or generate complex motions. Lee fails

* The Office Action referred to "Butcher (0998667)." In an October 14, 2003 telephone conference, the Examiner indicated that the rejection should have referred to Butcher, WO 94/02965, i.e., the International publication corresponding to GB 2,284,2998. For ease in referencing, the reference is again referred to simply as "Butcher" in the discussion.

to disclose that the induced output signal has a phase which is determined by the predetermined direction of polarization of the ferroelectric layer.

Moreover, even if one of ordinary skill in the art would have found Lee to teach three layers of piezoelectric/ferroelectric layers wherein the electrodes are disposed on the top, bottom and sides of each laminate layer for the purpose of inducing bending and tortional movement, the presently claimed invention still would not have been achieved. Specifically, nothing in Lee remedies the deficiencies of Butcher.

As discussed above, Butcher nowhere discloses the fundamental aspects of the present invention, namely the presence of a ferroelectric material layer which has a predetermined direction and polarization, that the induced output signal does not affect that polarization direction and that the phase of the induced output signal is determined by the polarization direction.

Accordingly, Applicant respectfully submits that Butcher and Lee, whether taken singularly or in combination, would not have led one of ordinary skill in the art to the invention of claim 1 or depending claims 6 and 7. Reconsideration and withdrawal of this rejection are thus respectfully requested.

III. Allowable Subject Matter

Applicant notes that the Patent Office, under the rejection of claims 6 and 7 for allegedly being unpatentable over Butcher in view of Lee, alleges that claims 3-5 and 8-10 have no structural limitation. However, the Patent Office fails to make any specific rejection of claims 3-5 and 8-10, and further fails to even mention claims 11 and 12. As no specific rejection of claims 3-5 and 8-12 has been made, Applicant assumes that each of claims 3-5 and 8-12 is in condition for allowance. If this is not the case, Applicant requests the Patent Office to clarify the status of claims 3-5 and 8-12 in the next Office Action.

IV. Non-Finality of Office Action

Applicant notes that although the prior Office Action was marked as being final on the cover sheet, the Office Action itself is indicated to be non-final. Further, the PAIR system confirmed that the Office Action was non-final. Thus, Applicant understands the Office Action to be non-final, and as such, changing the status to final after this response has been filed would be prejudiced and inappropriate.

V. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of claims 1-15 are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,



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